



DUAL-BIOPHASETM OXIDATION TECHNOLOGY

CLEAN AND "GREEN" TECHNOLOGY

-  *Ultra low CO₂*
-  *Does not produce NO_x, CO, SO_x*
-  *Operates at ambient temperature*

Solutions

FOR YOUR **AIR** POLLUTION CONTROL NEEDS



PROCESS COMBUSTION CORPORATION

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Process Combustion Corporation's Dual-BioPhase™ Systems, provide an economical and environmentally friendly method of treatment for a wide range of organic and inorganic air emissions. PCC's Dual-BioPhase™ Systems are fully automated and custom engineered to meet or exceed the performance requirements for odor or VOC applications.

What is Bio-Filtration?

Bio-filtration is a biological process that uses micro-organisms to convert Volatile Organic Compounds (VOCs), Hazardous Air Pollutants (HAPs), and Odor causing compounds into harmless by-products, i.e., carbon dioxide (CO_2) and water (H_2O).

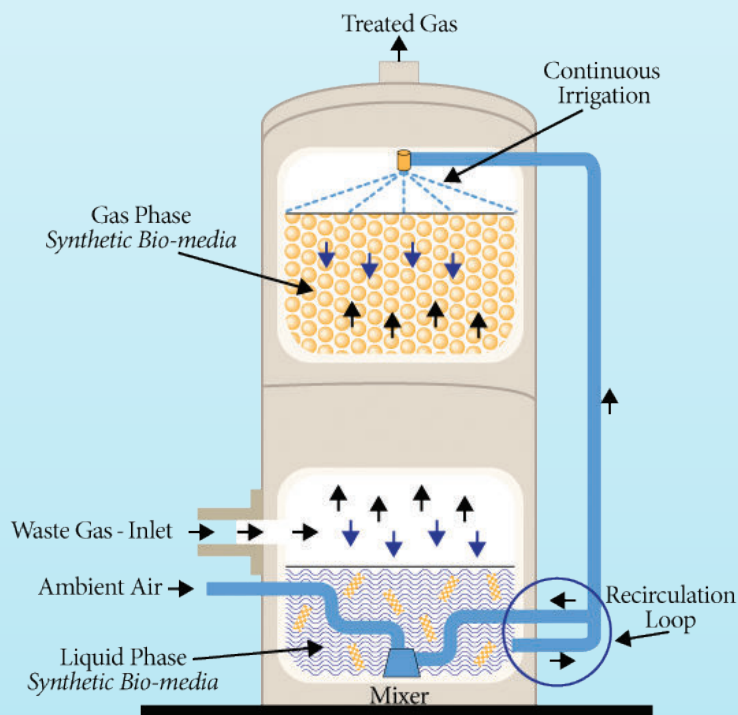
Since the introduction of the technology in the 1960's, most bio-filters have used naturally bioactive media such as peat, compost, soil or wood chips to biologically degrade odors and VOC's. Recognizing the limitation associated with these organic media systems and other conventional odor control technologies, the PCC Dual-BioPhase™ System offers innovative bio-oxidation process that achieves an entirely new level of performance for biological air treatment systems.

What is a PCC Dual-BioPhase™ Bio-Oxidation System?

Pollutant compounds that dissolve in water are treated in the water phase while compounds that remain in air are treated in the gas phase. The Dual-BioPhase™ Technology utilizes synthetic media on which contaminant degrading bacteria are immobilized as biofilm on the surface of the media. As air flows through the bed of media, the contaminant comes in contact with the active biofilm that degrade the pollutant compounds. At the same time, a continuous stream of water flows down through the media to keep the biofilms moist and biologically active.

The system achieves maximum treatment efficiency by adding a nutrient biocatalyst to the water that circulates through the Gas Phase Biological Oxidation Section so that the airborne contaminants are adsorbed into the water where they are biodegraded by the aqueous culture.

Thus, with the PCC Dual-BioPhase™ System, contaminant compounds in the air are biodegraded by the active cultures in the liquid phase as well as by the active biofilms on the surface of the synthetic gas phase media.



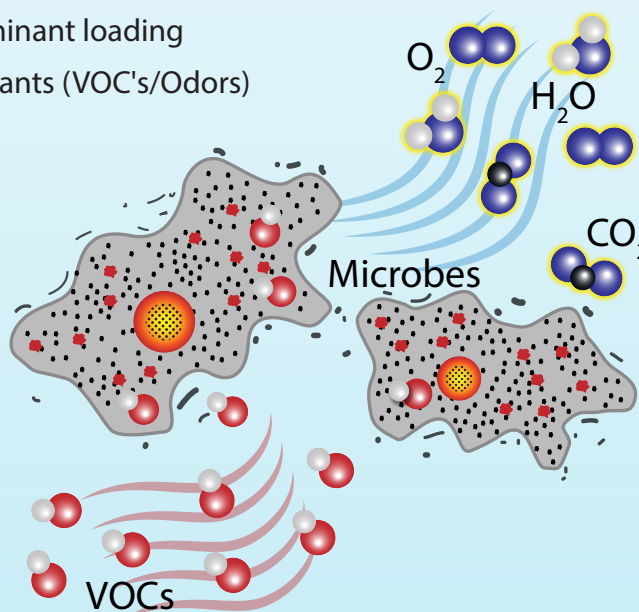
Synthetic Media

Dual-BioPhase™ technology offers important state-of-the-art improvements that translate into tangible performance and economic benefits. Foremost is the unique synthetic media specifically for the Dual-BioPhase™ Bio-Oxidation Process. PCC's synthetic media is designed for low pressure drop and allows ample room for biofilm growth without clogging due to excessive microbial growth. It achieves hydrophilic properties to retain water and support the growth of biofilms on the media surface.

Advantages of PCC Dual-BioPhase™ System vs. Traditional Biofilters

Superior performance of synthetic media allows for:

- Higher gas velocity - reduced size of biofilter
- Shorter gas residence time
- Quicker response to fluctuations in contaminant loading
- Handle higher concentrations of contaminants (VOC's/Odors)
- No fouling/clogging



Evaluation Category	Traditional Biofilter	Dual-BioPhase™ BioOxidation Process
Microorganisms and Nutrients are Restrained within Media	Yes	No
Media Replacement is Required to Replenish Nutrients	Yes	No
Media needs Continually Fluffed to Obtain Porosity	Yes	No
Biomass Growth Causes Media Settling	Yes	No
Continually Increasing ΔP	Yes	No
Maintaining Optimal Water Content is Crucial	Yes	No
Media Height Limited to Maintaining Proper Moisture Content	Yes	No
Capacity for Contaminants - ppmv	< 50	< 5,000
Limited Capacity to Neutralize Acids	Yes	No

Application

- Wood Products - OSB, MDF, Pellets, etc.
- Bioenergy, Biofuel, Biomass Energy Plants
- Pharmaceutical
- Tank Farms, etc.
- Food Manufacturing

Competing Technology

- Traditional Biofilters
- Regenerative Thermal Oxidizers (RTO/RCO)

PCC's Dual-BioPhase™ Technology and RTO/RCO technologies typically compete in applications where HAP and VOC concentrations are low (<5000 ppmv). Typical VOC's treated are; Aromatic Hydrocarbons, Alcohols, Aldehydes, Esters, Ethers, and Ketones.



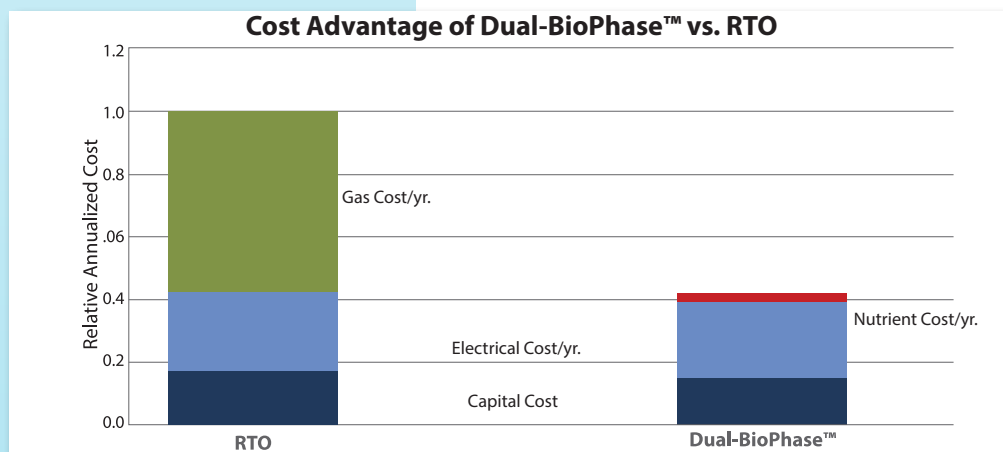
Green House Gas

RTO/RCO's use high temperature to oxidize the chemicals to carbon dioxide (CO₂) and water. Typically, natural gas is used to effectively maintain the destruction temperature required to prevent emission of unreacted hydrocarbons. One drawback to burning natural gas is that it creates Green House Gases (GHGs) and unfavorable by-products CO, CO₂, NO_x and SO_x, etc. PCC's Dual-BioPhase™ Systems use micro-organisms to biologically convert the organics to carbon dioxide and water thereby producing significantly less CO₂ vs. thermal oxidation. Because there is no flame involved with biofilters, there is no CO, NO_x or SO_x produced.

Evaluation Category	RTO	Dual-BioPhase™
Burns Natural Gas - Additional Operating Cost	Yes	No
Valve Maintenance - Wear & Tear	Yes	No
Potential Fouling of Ceramic Media	Yes	No
Strict Thermal Safety Requirements (1500°F)	Yes	No
CO Emission	Yes	No
CO ₂ Emission	Yes	~95% Less
NO _x Emission	Yes	No
SO _x Emission	Potential	No
Particulate Removal Required with Wet-ESP	Yes	No
Potential Treatment of Waste Gases	Yes	No

Economics

Typically, capital cost is similar, however, the operating cost of a PCC Dual-BioPhase™ system is considerably less than an RTO. Environmental impact is also a significant factor to consider.





Application

- Industrial Processes
- Waste Water Treatment Plants
- Solids Handling
- Lift Stations
- Unidentified Odors

Competing Technology

- Traditional Biofilters
- Carbon Adsorption
- Chemical Scrubbing
- Water Scrubbing

PCC's Dual-BioPhase™ System - This uniquely designed process overcomes the inherent drawbacks of its competing technology including maintaining proper pH balance. This is especially significant when treating Hydrogen Sulfide (H_2S). It is well known that H_2S can be biodegraded under acidic conditions. However, at low pH many organic sulfur compounds, such as mercaptans and disulfides, which are typically responsible for most wastewater odors, do not biodegrade. PCC's Dual-BioPhase™ Bio-Oxidation System does it all.

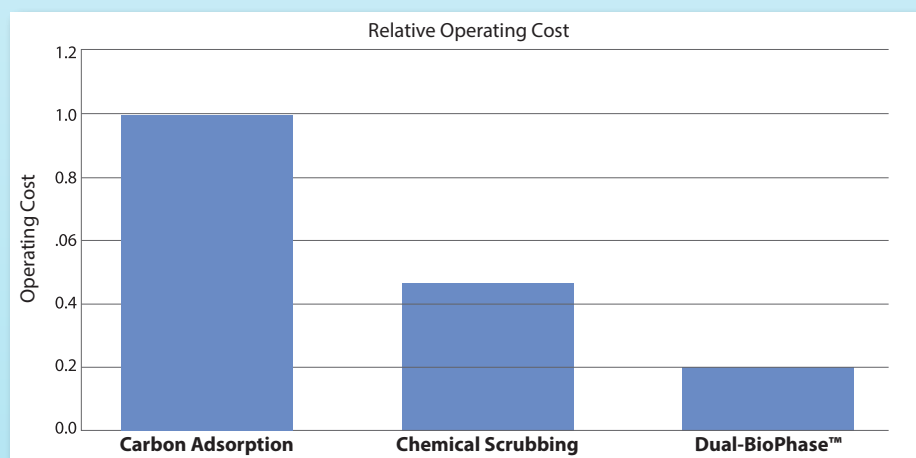
Adsorption - Adsorbents (i.e. Activated carbon, zeolites, etc.) are costly without regeneration and when inlet concentrations are greater than 5 ppmv. Compounds such as hydrocarbons can also pose a fire hazard.

Chemical Oxidation - Using chemicals such as ozone, hydrogen peroxide, chlorine, and potassium permanganate are costly and produce by-products to be treated e.g. halocarbons, peroxide, etc.

Water Scrubbing - Can be used for water soluble compounds. However, the contaminant is simply removed from the gas and transferred into the liquid which must still be oxidized. Particulates in the gas may clog the packing media.

Economics

As can be seen in the graph (below) a PCC Dual-BioPhase™ system offers significantly lower operating cost compared to competing odor control technology.



MISSION STATEMENT... PCC's mission is to apply our know-how with confidence to design, supply and service high-tech, energy-efficient, dependable combustion and pollution control systems that provide cost effective environmental solutions for our global customers.

We will work hard together to achieve mutually rewarding, long-term relationships with our clients and suppliers, and we will continuously develop new technologies to meet emerging market needs.

A Message from the President...

"Through the use of our engineering and application expertise, PCC will design and supply a quality system, delivered on time, that will meet all of your project requirements."

Our Core Values

-  **Know-How** - Experienced, Knowledgeable & Competent - PCC's #1 Core Value
-  **Hardworking** - Working Hard Together to Get the Job Done
-  **Confidence** - Our Confidence in Our Abilities = Customer Confidence
-  **Customer Focus** - Custom Design with a Friendly, Willing Spirit
-  **Dependable** - Meeting Commitments to Our Customers & Owners

For 50 years, Process Combustion Corporation (PCC) has designed, supplied & serviced combustion, heat transfer & pollution control systems worldwide. Headquartered in Pittsburgh, PA, USA; with offices in Beijing, China; and London, England; PCC is recognized as a global leader in pollution control systems. Our creative designs minimize system costs, especially energy consumption, while meeting environmental regulations. Our capabilities include:

-  **Thermal Oxidizer Systems**
-  **Regenerative Thermal Oxidizers**
-  **Flameless Thermal Oxidizers**
-  **Bio-Oxidation Systems**
-  **Wet Scrubbers**
-  **Activated Carbon Adsorption**
-  **Air Heaters**
-  **Specialty Burners**
-  **Specialized Combustion Systems**
-  **Low NO_x, SCR/SNCR Systems**
-  **Landfill Gas Thermal Oxidizers**
-  **Service & Installation**
-  **Engineering Studies**
-  **Turnkey Projects**



Located in the South Hills of Pittsburgh, PA, PCC's Administration, Sales, Engineering, Manufacturing and Research & Development are housed in one location.

PCC has enjoyed successes working with the following companies (partial list) over the years. Our goal is always to be sure our customers are satisfied with quality, custom-designed and engineered, reliable products and services.



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to Energy Plant

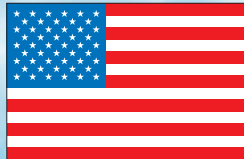
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Representatives are located in major US Cities, Canada, Asia, and selected countries, visit www.pcc-group.com to find your local agent.



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